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(54) **High precision sub-pixel spatial alignment of digital images**

(57) A high precision sub-pixel spatial alignment of digital images, one from a reference video signal and another from a corresponding test video signal, uses an iterative process and incorporates spatial resampling along with basic correlation and estimation of fractional pixel shift. The corresponding images from the reference and test video signals are captured and a test block is overlaid on them at the same locations to include texture from the images. FFTs are performed within the test block in each image, and the FFTs are cross-correlated to develop a peak value representing a shift position between the images. A curve is fitted to the peak and

neighboring values to find the nearest integer pixel shift position. The test block is shifted in the test image by the integer pixel shift position, and the FFT in the test image is repeated and correlated with the FFT from the reference image. The curve fitting is repeated to obtain a fractional pixel shift position value that is combined with the integer pixel shift value to update the test block position again in the test image. The steps are repeated until an end condition is achieved, at which point the value of the pixel shift position for the test block in the test image relative to the reference image is used to align the two images with high precision sub-pixel accuracy.

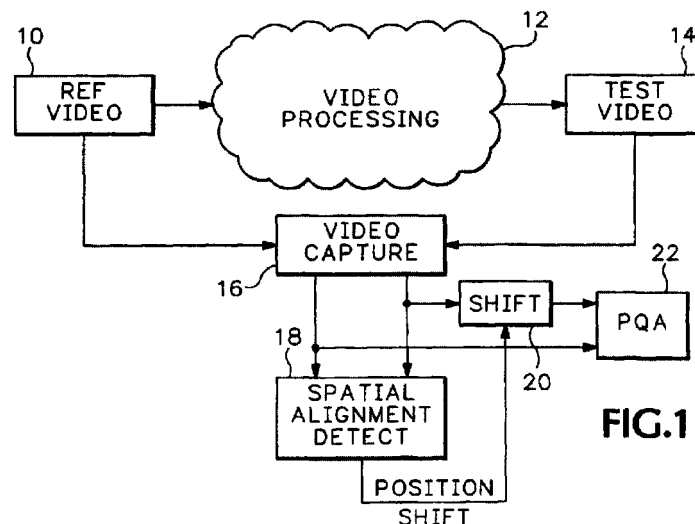


FIG.1



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 8763

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	HRISTOV D H ET AL: "GREY-LEVEL IMAGE ALIGNMENT ALGORITHM FOR REGISTRATION OF PORTAL IMAGES AND DIGITALLY RECONSTRUCTED RADIOGRAPHS" MEDICAL PHYSICS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 23, no. 1, January 1996 (1996-01), pages 75-84, XP000554238 ISSN: 0094-2405 * page 77, left-hand column, paragraph B - page 79, left-hand column, paragraph III *	1,2	G06T7/00
Y	EP 0 366 165 A (PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED) 2 May 1990 (1990-05-02) * claim 1 *	1,2	
A	SCOTT C. DOUGLAS: "A frequency-domain subpixel position estimation algorithm for overlay measurement" PROCEEDINGS OF THE SPIE; INTEGRATED CIRCUIT METROLOGY, INSPECTION, AND PROCESS CONTROL VII, SAN JOSE, CA, USA, 2-4 MARCH 1993, vol. 1926, March 1993 (1993-03), pages 402-411, XP001039575 * page 407, line 7-10 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			G06T
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 6 November 2001	Examiner Chateau, J-P
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPC FORM 1503 03.92 (PC4001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 30 8763

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-11-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 366165 A	02-05-1990	GB 2222498 A	07-03-1990
		DE 68922689 D1	22-06-1995
		DE 68922689 T2	16-11-1995
		EP 0366165 A2	02-05-1990
		JP 2108394 A	20-04-1990
		JP 2947361 B2	13-09-1999
		US 5008744 A	16-04-1991
